liquid thermosetting adhesive 306b semi-solidified as described above" is the object obtained by semi-solidifying the thermosetting adhesive 306b as described in connection with the eighteenth embodiment, similar to the object put in the B stage. By using this, a material less expensive than the sheet encapsulating material or ACF (Anisotropic Conductive Film) can be utilized. At this time, in a supersonic wave applying device 620 as shown in Fig. 57, the gold bumps 3 are metallically bonded to the gold platings located on the board side while shaping the tips so as to prevent the collapse of neck portions at the tips of the gold bumps 3 by effecting a load of an air cylinder 625 applied from the upper surface of the IC chip 1 sucked and held by the pre-heated bonding tool 628 with a built-in heater 622 and the supersonic waves that are generated by a supersonic wave generating element 623 such as a piezoelectric element and applied via a supersonic wave horn 624. Next, the IC chip 1 is pressed against the circuit board 4 with a pressure force of not smaller than 20 gf per bump while heating the IC chip 1 from the upper surface side of the IC chip 1 and/or from the board side so as to correct the warp of the board 4 and crush the bumps 3, and the thermosetting resin sheet 6 or the thermosetting adhesive 306b interposed between the IC chip 1 and the circuit board 4 is hardened by the heat so as to bond the

IC chip 1 to the circuit board 4, electrically connecting both the electrodes 2 and 5 together.

The reason why the pressure force of not smaller than 20 gf per bump is needed is that the bonding cannot be achieved since frictional heat scarcely occurs even by the bonding using supersonic waves as described above. Also, when bonding gold to gold together, frictional heat is generated by pressing the bump with a specified constant load and applying supersonic waves to the portion, by which the metals are bonded together. Therefore, even in this case, the specified load sufficient for pressurizing the bump, i.e., the pressure force of not smaller than 20 gf per bump is needed. For example, the pressure force is set to 50 gf or more per bump.

According to the nineteenth embodiment, the metal bump 3 and the metal plating of the board 4 are subjected to metallic diffusion bonding, and this arrangement is therefore appropriate for giving a strength to the bump portion or further reducing the connection resistance value.

(Twentieth Embodiment)

A method and apparatus for mounting an electronic component of, for example, an IC chip on a circuit board and an electronic component unit or module of, for example, a semiconductor device in which the IC chip is mounted on the board by the mounting method, according to the

twentieth embodiment of the present invention will be described next with reference to Fig. 45A through Fig. 45C and Fig. 46A through Fig. 46C. The twentieth embodiment differs from the sixteenth embodiment in that the encapsulation process can be eliminated.

As described above, the protruding electrode (bump) 3 is preparatorily formed on the electrode 2 of the IC chip 1. On the circuit board 4, as shown in Fig. 45B, Fig. 45C, Fig. 46A and Fig. 58, a rectangular sheet-shaped thermosetting resin sheet 6 or a thermosetting adhesive 306b that has a configurational dimension smaller than an approximately rectangle-shaped outline dimension OL defined by joining the inner edges of the plurality of electrodes 2 of the IC chip 1 is preparatorily stuck or applied to a center portion of a region defined by joining the electrodes 5 of the circuit board 4. At this time, the thickness of the sheet-shaped thermosetting resin sheet 6 or the thermosetting adhesive 306b is set so that its volume becomes slightly greater than a gap between the IC chip 1 and the board 4. By means of the sticking device 640 of Fig. 58, a rectangular sheet-shaped thermosetting resin sheet 656 that is rewound from a rewinding roll 644 and wound around a winding roll 643 is cut along portions preliminarily provided with notches 657 by upper and lower cutter blades 641 into a configurational dimension smaller